

# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Article 36 and Rule 70)

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Applicant's or agent's file reference <b>P02069</b>	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. <b>PCT/NO 03/00423</b>	International filing date (day/month/year) <b>17.12.2003</b>	Priority date (day/month/year) <b>23.12.2002</b>
International Patent Classification (IPC) or both national classification and IPC <b>E21B43/12</b>		
Applicant <b>NORSK HYDRO ASA ET AL.</b>		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.


2. This REPORT consists of a total of 4 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand  <b>18.06.2004</b>	Date of completion of this report  <b>12.01.2005</b>
Name and mailing address of the International preliminary examining authority:   <b>European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465</b>	Authorized Officer  <b>Diaz y Diaz-Caneja,</b>  Telephone No. +49 89 2399-7534



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/NO 03/00423

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, Pages**

1-12 as originally filed

**Claims, Numbers**

1-15 filed with telefax on 20.12.2004

**Drawings, Sheets**

1/3-3/3 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).  
☐ the language of publication of the international application (under Rule 48.3(b)).  
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.  
☐ filed together with the international application in computer readable form.  
☐ furnished subsequently to this Authority in written form.  
☐ furnished subsequently to this Authority in computer readable form.  
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.  
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☒ the claims, Nos.: 16  
☐ the drawings, sheets:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. **PCT/NO 03/00423**

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes: Claims	1-15
	No: Claims	
Inventive step (IS)	Yes: Claims	1-15
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-15
	No: Claims	

2. Citations and explanations

**see separate sheet**

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

- D1 (US-A-5 544 672), discloses the following features:

A system for prediction and treatment of all kinds of slugs being formed in a flow line 10 system or wellbore tubing transporting a multiphase fluid towards a downstream process including at least one separator 12 or slug catcher at said process inlet, wherein said system comprises:

- a slug detector 28 dedicated to detect any incoming slug which is located between the point of slug initiation and said process inlet, (see column 3, lines 14-19)
- a computer unit 33 connected to said detector and either a multiphase flow meter (30, 32) or a fluid velocity meter (see column 3, lines 41-49 and column 5, lines 12-15) located upstream an inlet choke 26 in said flowline system
- instruments connected to said computer unit continuously monitoring pressure and liquid levels 22 in said separator or slug catcher (see column 2, lines 60-67).

The problem may be regarded as how to improve the detection of the slugs.

This problem is solved in the known system through the distinguishing features of claim 1. Indeed these features result in a better prediction and handling of incoming slugs and reduces the perturbation caused by the slugs to a minimum. D1 throttles down the production when there is slug and it prolongs the start-time after shut-down whereas claim 1 regulates pressure and/or liquid level in the separator, accelerating the process.

Since said distinguishing features are neither known nor suggested by the prior art documents the subject-matter meets the requirements of Art. 33(2)-(4) PCT.

The same problem and solution approach applies for the corresponding method claim 10 which includes the same characterising features.

- Following should have been taking into account:
- Rule 6.3 (b) PCT: correct two-part form of independant claims 1 and 10.

**Amended Claims (20.12.2004):**

- 5 1. A system for prediction and treatment of all kinds of slugs being formed in a flow line (20) system or wellbore tubing transporting a multiphase fluid towards a downstream process including at least one separator or slug catcher (8) at said process inlet,

**characterised in that**

10 said system comprises:

- a slug detector (1) dedicated to detect any incoming slug which is located between the point of slug initiation and said process inlet,
- a computer unit (4) connected to said detector (1) and either a multiphase flow meter (5) or a fluid velocity meter located upstream an inlet choke (19) in said flow line (20) system, and where said unit (4) includes software which based on signals from said slug detector (1) in combination with signals from either said meter (5) or fluid velocity meter determines the nature of said slug and estimates its volume and its arrival time to said process,
- 20 - instruments connected to said computer unit (4) continuously monitoring pressure and liquid levels in said separator or slug catcher,
- at least one device connected to said separator or slug catcher which receives signals from said computer unit (4) to regulate the pressure and/or liquid level in said separator or slug catcher so that process perturbations due to incoming slugs are reduced to a minimum through said process.

2. A system according to claim 1,  
**characterised in that**

30 said instruments comprise at least one liquid level transmitter (9,11,18) and/or at least one pressure transmitter (3,16) mounted to said separator or slug catcher.

3. A system according to claim 1,

**characterised in that**

said device comprises at least one valve (6,7,12,17) and/or at least one compressor (14) and/or at least one pump (15).

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4. A system according to claim 1,

**characterised in that**

said slug detector (1) comprises instruments in said flow line (20) for measuring flowing pressure, fluid mixture density and at least gas void fraction or water cut or local hold-up.

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5. A system according to claim 1,

**characterised in that**

the distance (2) from the slug detector (1) to the downstream process equipment is for every new implementation optimised with respect to slug treatment capabilities of said process and the parameter settings of all regulating devices being controlled by said computer unit (4).

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6. A system according to claim 1,

**characterised in that**

the optimum location for said detector (1) could either be in said flow line (20) some distance (2) upstream of said process or within a riser (13).

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7. A system according to claim 1,

**characterised in that**

the computer unit (4) includes three options for defining the fluid velocities; by manual input, by on-line registration using clamp-on fluid velocity meter or by including an on-line transient simulator in combination with a multiphase meter (5) at the flow line outlet.

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8. A system according to claim 1,  
**characterised in that**

the computer unit (4) integrates said flow line system (20) and said downstream process by adjusting the pressure and liquid level regulating devices based on arrival slug information.

9. A system according to claim 1,  
**characterised in that**

the computer unit (4) comprises override functions that override or suppress the slug control regulation of the downstream process if the trip levels of the separators are approached.

10. A method for prediction and treatment of all kinds of slugs being formed in a flow line (20) system or wellbore tubing transporting a multiphase fluid towards a downstream process including at least one separator or slug catcher (8) at said process inlet,  
**characterised in that**

said method comprises the following steps:

said slug is detected between the point for slug initiation in said flow line (20) and said process inlet by means of a slug detector (1),

the nature of said slug is determined by means of a computer unit (4) continuously receiving signals from said slug detector (1) in combination with either a fluid velocity meter or a multiphase flow meter (5) located upstream of an inlet choke (19) in said process,

the volume of said slug and its arrival time to said process are estimated by said computer unit (4),

pressures and liquid levels in said separator or slug catcher are monitored by said computer unit (4) by means of instruments (3,9,11,16,18) mounted to said separator or slug catcher,

said computer unit (4) gives signals to at least one device (6,7,12,14,15,17) connected to said separator or slug catcher to regulate the pressure and/or

liquid level in said separator or slug catcher so that process perturbations due to incoming slugs are reduced to a minimum through said process.

11. A method according to claim 10,

5 **characterised in that**

said slug detector records continuously flowing pressure, fluid mixture density and at least gas void fraction or water cut or local hold-up.

12. A method according to claim 10,

10 **characterised in that**

said pressure and/or liquid levels are regulated by means of at least one valve (6,7,12,17) and/or at least one compressor (14) and/or at least one pump (15) connected to said separator or slug catcher.

15 13. A method according to claim 10,

**characterised in that**

said pressure regulation is achieved by adjusting choke opening of at least one gas outlet valve (6,17) or by adjusting the speed of a downstream compressor (14).

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14. A method according to claim 10,

**characterised in that**

said liquid level regulation is achieved by adjusting choke opening of at least one liquid outlet valve (7,12) or by adjusting the speed of a down-stream pump (15).

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15. A method according to claim 10,

**characterised in that**

the flow rate in said flow line is adjusted by means of said inlet choke (19).

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